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CRUSHING ROLLS

THEIR CARE AND UPKEEP

ALSO

DATA

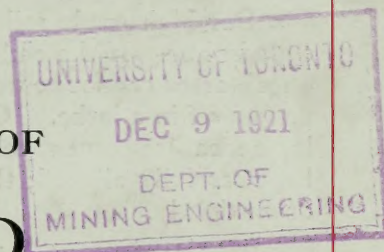
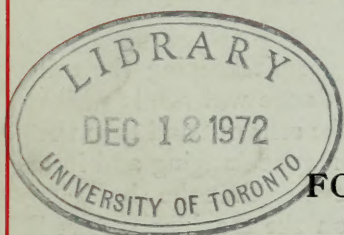
FOR THE DETERMINATION OF

SIZES OF FEED

PERIPHERAL SPEEDS

AND

CAPACITIES



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MILWAUKEE, WIS., U. S. A.

By Allis-Chalmers Manufacturing Company

CARE AND UPKEEP OF CRUSHING ROLLS

There is no piece of apparatus used in the equipment of a rock or ore crushing plant that requires more careful attention in its installation and operation than crushing rolls. While this is a comparatively simple machine, it requires more than ordinary attention to maintain it in good working condition to produce the best results.

Assuming that the crushing rolls in a plant are of a design and construction suitable for the particular work to be done, it is important that all adjustments be carefully made and watched to keep them in good running order.

The method of feed, as well as the size of material fed, are of primary importance. The material to be crushed should be delivered in a constant and regular stream to the machine—a belt or conveyor feeder is best adapted for this work.

The spout feeding the rolls should always be placed at right angles to the roll shaft and should be level so that the material running down the spout is evenly distributed over its whole width. The feed spout should be the same width as the face of the rolls; if the spout is narrower, the feed will drop into the center, wearing the roll faces hollow. When this occurs, rods or some other divider should be placed across the feed hopper to throw the feed to the ends until they are worn down even with the center.

Our high grade rolls are provided with adjusting collars to permit keeping the roll ends in line. If the end of one roll projects beyond the other, a flange will result which once started cannot be worn down and the only remedy is to take the rolls out and turn the flanges off in a lathe. Careful use of this adjusting device will prevent flanging and in a large measure prevent corrugating of the roll faces. It is also necessary that the shafts be kept carefully aligned; the springs compressed and all the nuts on the machine screwed down tightly.

The bearings must be kept well lubricated and if, by accident, one of the bearings should wear the babbitt so that the shaft is lowered, it should be re-babbitted at once because if allowed to run for any length of time out of alignment the faces of the roll shells will wear hollow.

One of the frequent causes for trouble in-operating rolls is that the spring pressure is not maintained, usually because the nuts on the bolts are allowed to get loose. Our rolls are designed with spring pressures sufficient to crush the material for which they are intended and there should be no vibration or closing of the springs when rock only is fed. Springs are put on rolls as a safety device to prevent breakage of frames and tension rods when steel or other unbreakable material is accidentally delivered with the feed. To obtain the highest efficiency, the springs should be compressed at all times to exert the pressure for which they are designed and set at the factory. If the nuts on the bolts compressing the springs are allowed to become loose, permitting the springs to expand, the crushing pressure is thereby reduced, under these conditions the rolls will chatter and vibrate to such an extent that breakage of tension rods or other trouble is likely to result.

CRUSHING ROLLS

For each side of the roll frame there is provided a set of shims or distance pieces of various thicknesses to regulate and maintain a desired opening between the roll faces. Care should be exercised to see that the spacing is maintained by the use of these shims or otherwise the roll faces may slap together, causing violent shocks, which will in time cause the breakage of pulleys, shafts or tension rods.

When replacing shells be sure that the loose head is drawn in tightly to prevent slipping of the shells, and even after drawing up on the bolts all possible, oftentimes by working a ram against the loose head, an extra turn on the nut is possible; also after rolls have been operating three or four days it would be well to tighten up the head bolts.

It is good practice to go over all the bolts on the rolls at frequent intervals, say every two weeks, because the vibration due to operating may occasionally loosen the nuts on the bolts and this should of course be guarded against.

Some manufacturers offer crushing rolls fitted with an automatic oscillating device, claiming that it will increase capacity and prevent corrugating.

For the benefit of prospective purchasers or present users of our rolls will say that we have at various times tried out automatic oscillating devices and in fact have one that operates mechanically perfect which we can furnish if desired, but we do not recommend the use of same as it will not increase capacity nor prevent corrugating of the shell faces if the causes which produce corrugating are not eliminated.

The only cause for the corrugation of roll shells is abrasion and abrasion can only be produced in two ways; first, if the material fed is larger than the crushing angle of the rolls will bite. In that case, the large pieces ride until they are reduced by abrasion to a size that the rolls can take in. This is the principal cause for corrugation. The second prolific cause is in the differential speed at which the roll faces frequently run.

In new rolls, the outside diameters of the two shells should be the same, but as the faces of roll shells are given only a rough finish, it frequently happens that there is a small difference. Also if rolls are built with two large driving pulleys, the traction power of the pulleys is sufficient to overcome the friction between the faces of the rolls when crushing, therefore, when there is a difference in the diameter of the rolls or in the diameter of the two pulleys, or in both, there is a differential in the circumferential speed which produces abrasion. This will inevitably cause the faces of the shells to become corrugated.

To overcome this difficulty, we have, in late years designed all of our crushing rolls with a large driving pulley on the fixed shaft. This pulley has sufficient surface to transmit all the power required for the work the rolls are called upon to do. The movable roll shaft is fitted with a pulley about half the diameter and usually half the face, the function of this smaller pulley being only to keep the movable roll rotating when not crushing. When the rolls are crushing, the friction between the roll faces rotates the movable roll and the traction power of the small pulley not being sufficient to overcome the friction, there is no difference in circumferential speed and consequently no abrasion and corrugation.

DATA FOR FIGURING CAPACITY OF ROLLS

The capacity of Rolls is influenced by the character of the material and the fineness of reduction. It is manifestly impossible to anticipate the various conditions incident to the reduction of ores, owing to the wide range in their character. Therefore, a reliable formula for calculating capacity which is applicable to all conditions is impossible, but as a guide, we give the following:

The capacity of crushing rolls is in direct ratio to the width of face and peripheral speed and is calculated by the formula—

$$T \times W \times S = \text{cubic feet per minute}$$

1728

T = Distance in inches roll faces are set apart

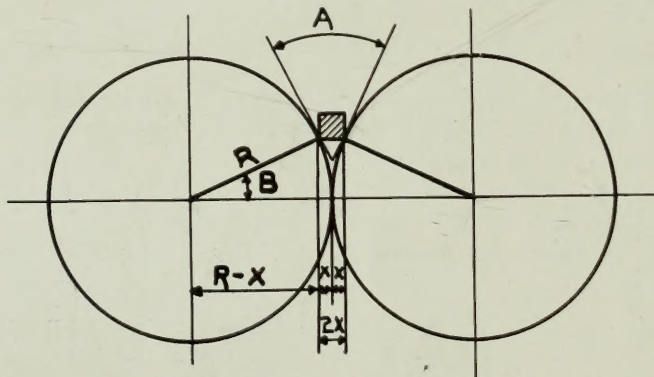
W = Width in inches roll faces

S = Peripheral speed inches per minute

This gives the theoretical capacity which, on account of irregularity in feed, etc. should be divided by 4 to give the actual capacity.

Plate No. 12355 illustrates the method of determining the maximum size of feed for Rolls of a given diameter. In the following table these sizes are given for our standard Rolls.

Cut No. 12355



Let R = Radius of Roll

A = Wedge Angle (31°)

B = Friction Angle, (16° 45')

Coef. of Friction is .3

Size of Pieces Rolls will take = 2X

$$\frac{\cos B}{R} = R - X$$

CRUSHING ROLLS

Dia. of Rolls	Size of Pieces	
9".....	.26"	} Plus the spread of the Rolls equals maximum size of pieces which Rolls will take.
12".....	.48"	
18".....	.72"	
24".....	.96"	
26".....	1.04"	
30".....	1.20"	
36".....	1.44"	
40".....	1.60"	
42".....	1.68"	
48".....	1.92"	
54".....	2.16"	
72".....	2.88"	

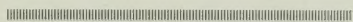
To the above maximum size of feed should be added the opening between roll faces, for instance—the maximum size piece which should be fed to rolls 30 inches diameter set $\frac{1}{4}$ inch apart would be 1.45 inches.

The peripheral speed at which rolls are usually operated is from 500 to 1200 feet per minute, varying with the size of the feed and also with the size of the machine.

It might be inferred that if all sizes of rolls are operated at the uniform speed of 1000 feet per minute, a 30x16" Roll would have the same capacity as a 42x16", but such is not the case for the reason that the revolving parts of the larger rolls having greater mass and weight, the momentum or kinetic energy stored up in them overcomes the sudden shocks due to irregularity in feed and hardness of material with greater ease.

The economical range of reduction for rolls of course varies to some extent with the material crushed but may be considered as being limited to from 12 to 16 mesh product; when finer product is required a ball granulator or tube mill will do the work at less cost.

The best ratio of reduction in one operation when crushing ore for treatment by gravity concentration, where a granular product with a minimum percentage of fines or slimes is desired, is about four to one, but when the product is to be further reduced by tube milling or other process of reduction, a ratio of seven or eight to one is permissible.



A graphic chart with explanation is shown on pages 6 and 7, covering capacity and speed for operation under various conditions.

CRUSHING ROLL DIAGRAM.

The crushing roll diagram for the determination of roll sizes, capacities and speeds on the following page, is intended to cover average conditions under which rolls are required to operate. On account of the varied conditions which govern capacities and speeds of rolls, it is manifestly impossible to calculate these quantities by any given formula. The formulas used in the calculation, however, give approximately correct results which can be relied upon for average conditions.

The diameter of rolls required to make a given reduction is determined by the maximum size of feed which can be nipped by the rolls without slippage. This size is calculated by the formula, $2X = .08R + T$, in which $2X$ is the maximum size of feed, R is the radius of the roll in inches, and T is the distance the roll faces are set apart.

The capacities given in tons per inch of face per hour are one-quarter of the theoretical capacities obtained by use of formula $\frac{T \times W \times S}{1728}$ = cubic feet per minute, in which T = distance in inches the roll faces are set apart, $W = 1'$ and SW peripheral speed in inches per minute. In the further calculation, the weight of ore is assumed to be 100 pounds per cubic foot.

The speeds given are recommended for average conditions and will give satisfactory results, except for small sampling rolls which should be run at about 140 to 160 R. P. M.

To illustrate the use of diagram, assume that it is required to reduce 25 tons per hour of 2 inch material to $\frac{1}{2}$ inch.

First, determine the diameter of the roll required. Find the size of feed (2 inches) in the column at the left of the diagram and follow the horizontal line leading from this size to the point of intersection with the diagonal $\frac{1}{2}$ inch product line in the series marked "Product lines to determine size of rolls." From this point follow the nearest vertical line to the top of the diagram. The roll diameter thus found (38 inches) is the theoretical minimum diameter which can be used to reduce 2 inch feed to $\frac{1}{2}$ inch. As this is not a standard diameter we would use 42 inch rolls.

Second, determine the speed at which the 42 inch rolls should run with a 2 inch feed. Find the size of feed on the curve marked "Size of feed in inches to determine the correct peripheral speed," and follow the horizontal line to the left, to the column marked "Peripheral speeds—feet per minute," which will give a speed of 700 feet per minute.

Third, determine the capacity of the 42 inch roll running at 700 feet per minute making a $\frac{1}{2}$ inch product. From the given speed (700 feet per minute) follow the horizontal line to the right, to the point of intersection with the $\frac{1}{2}$ inch product line in the series marked "Product lines to determine capacities." Directly underneath this point at the bottom of the table will be found a capacity given of 1.8 tons per hour per inch of face. From this we find that it will require a roll 14 inches wide to give a capacity of 25 tons per hour, but as this is not a standard width for a 42 inch roll, we would use a 42 x 16 inch roll.

Summing up the above we have determined that a 42 x 16 inch roll running at a speed of 700 feet per minute will reduce 28.8 tons of 2 inch material to $\frac{1}{2}$ inch per hour.

To find the R. P. M. of the roll at the above peripheral speed follow the curve for 700 feet per minute to the point where it intersects the vertical line under 42 inch diameter roll and then follow the horizontal line for this point to the right of the diagram where it will be found that this corresponds to 63 R. P. M.

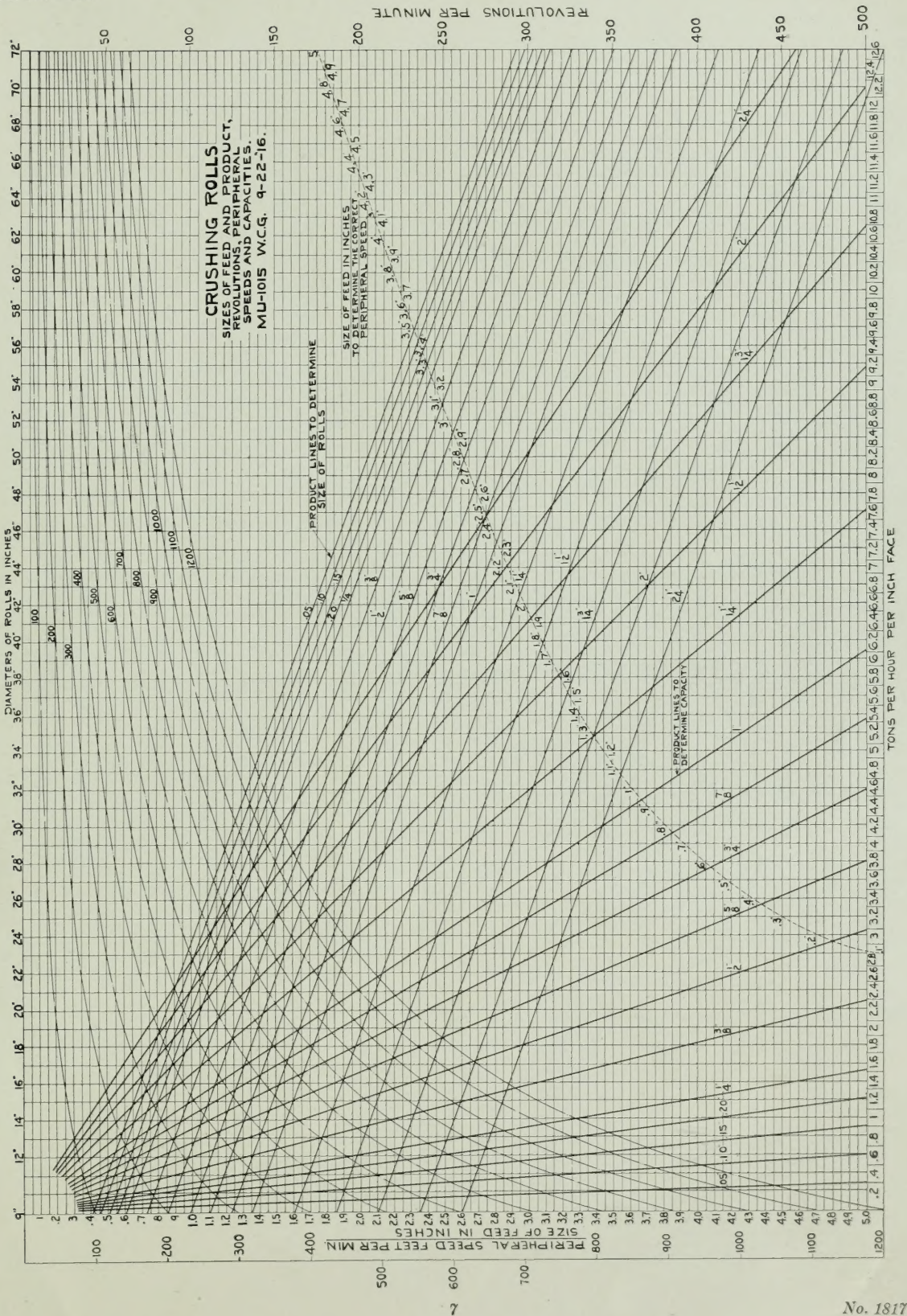
FACTORS FOR THE DETERMINATION OF CRUSHING ROLL CAPACITIES AT VARIOUS SPEEDS

In the calculation to determine the factors given in the following table, the weight of ore has been assumed to be 100 pounds per cubic foot. The capacities resulting from the use of the factors are 25 % of the actual theoretical capacities.

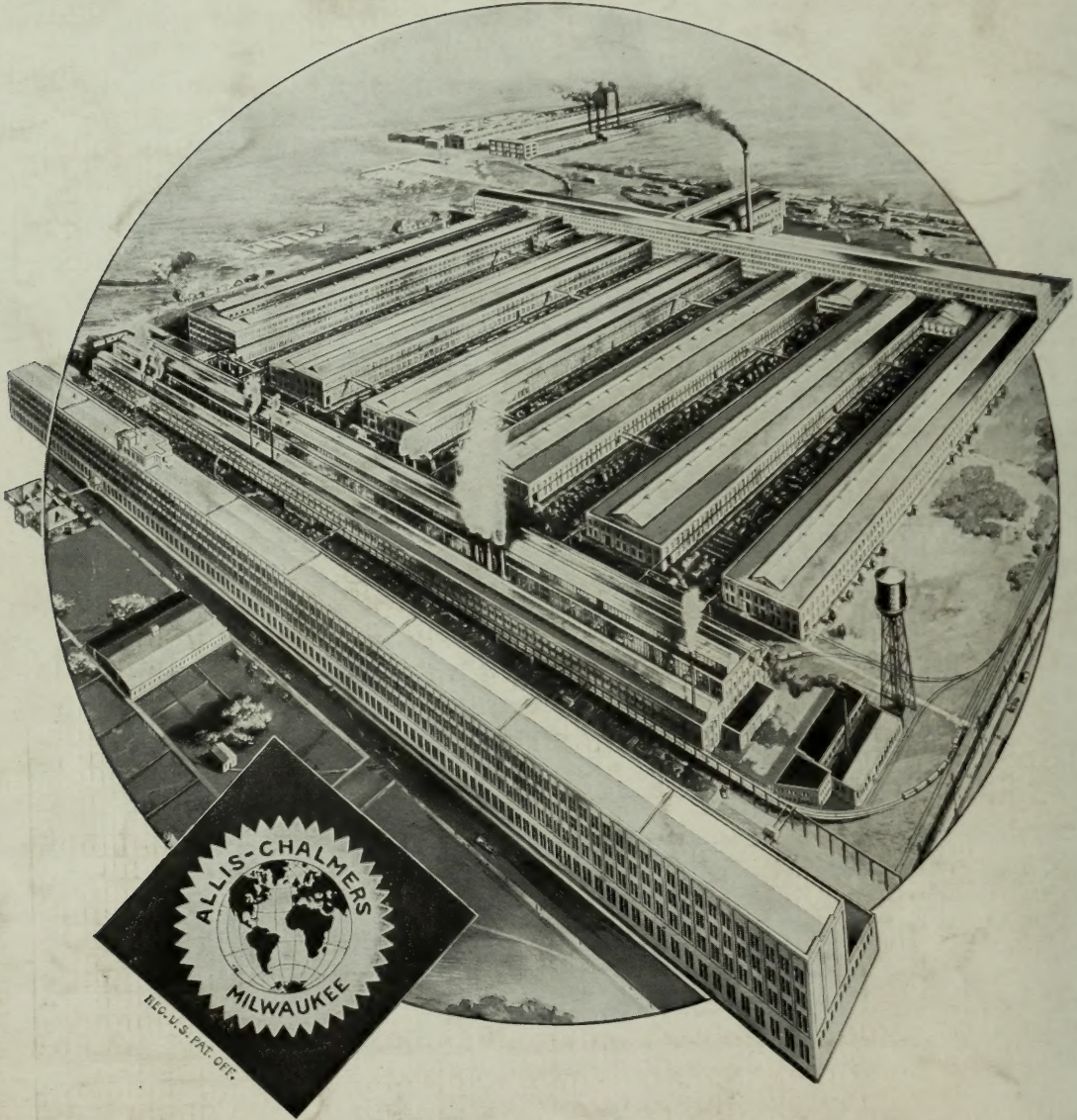
Multiply the factor opposite the required peripheral speed by the distance roll faces are set apart, in inches, and the result by the width of the roll face in inches. The result will be the capacity of the roll in tons per hour.

Peri. Speed F. P. M.	Factor	Peri. Speed F. P. M.	Factor	Peri. Speed F. P. M.	Factor
400	2.08	675	3.51	950	4.94
425	2.21	700	3.64	975	5.07
450	2.34	725	3.77	1000	5.20
475	2.47	750	3.90	1050	5.46
500	2.60	775	4.03	1100	5.72
525	2.73	800	4.16	1150	5.98
550	2.86	825	4.29	1200	6.24
575	2.99	850	4.42	1250	6.50
600	3.12	875	4.55	1300	6.76
625	3.25	900	4.68	1350	7.02
650	3.38	925	4.81	1400	7.28

CRUSHING ROLLS



Cut No. 13003



Bird's-eye view of Allis-Chalmers Mfg. Co.'s West Allis Plant.

District Offices in All Principle Cities.